Abstract

The analog method (AN) is used to generate ensemble-projections of local daily mean, minimum and maximum air temperatures in northwestern Spain (Galicia). A three-step method is followed:

1. From air temperature at 850 hPa and mean sea level pressure (T850+MSLP), chosen to be the best predictor combination for the purpose of this study, the error of the AN under optimal conditions is estimated. Besides a negative bias found for the maximum temperatures in spring the statistical properties of all predictands are reproduced well in every season of the year.

2. In a second step, the T850+MSLP-fields of 6 AR4-GCM control-runs of a multi-model, multi-init conditions ensemble (MIMMICE) are used to downscale the predictands, thus obtaining the total uncertainty. Neither the predictor data nor the downscaled series are corrected by bias adjusting, variance inflation or randomisation. While the individual downscaled series cannot reproduce the CDFs of local observations, their combination performs quite well during summer and autumn.

3. In a third step, 14 scenario-runs of the MIMMICE are used to generate summer (JJA) projections until 2050. Downscaled series from JJA 2021-2050 (scenario period) are compared to observations from JJA 1973-2002 (reference period) in order to detect local climate change.

We conclude that climate projections downscaled from only one GCM should be treated with caution, particularly if they refer to the suboptimal conditions. Besides, the uncertainty associated with the choice of ensemble members is estimated. Suboptimal conditions due to the downscaling method can be as important as the initial conditions or the forced uncertainties (fig. 6). The uncertainty intervals displayed as error bars are given by the standard deviation of the downscaled series (fig. 7 and 8). With $+0.7 \pm 0.2$ C to $+1.8 \pm 0.3$ C the mean relative warming is most pronounced for the Tmax in summer (JJA) (see fig. 7). A tripling to quadrupling of extreme heat days (Tmax > 37°C) is projected (fig. 8).

1 Validation under optimal conditions, JJA

2 Validation under suboptimal conditions, JJA

3 Climate projections: JJA 2021-2050 (SCE) to JJA 1973-2002 (REF)

References

- Bias = Bias
- SIGTEST = T-test for serially correlated data (0.1%)
- DPC10 = Downscaled - observed 10% percentile
- DPC90 = Downscaled - observed 90% percentile
- Bias, DPC10 and 90 DPC90 are scaled by the mean absolute deviation (MAD) of the observed series. Error bars are calculated with the bootstrap percentile method.

Due to its good validation results (step 2) the multi-model CDF (MM) provides the most credible projections. The spread of the local projections is dominated by model errors rather than by initial conditions or forcing uncertainties (fig. 6). The uncertainty intervals, displayed as error bars, are given by the standard error of 14 statistical values from 14 downscaled series (fig. 7 and 8). With $+0.7 \pm 0.2$ C to $+1.8 \pm 0.3$ C the mean relative warming is most pronounced for the Tmax in summer (JJA) (fig. 7). A tripling to quadrupling of extreme heat days (Tmax > 37°C) is projected (fig. 8).